

PATENT  
Attv. Dkt. 6303/CPI/COPPER/PJS

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of:

Chung, et al.

Serial No.: 09/965.370

Confirmation No.: Unknown

Filed: September 26, 2001

For: Integration of Barrier Layer  
and Seed Layer

Group Art Unit: Unknown

Examiner: Unknown

Assistant Commissioner for Patents  
Washington, D.C. 20231

Dear Sir:

CERTIFICATE OF MAILING  
37 CFR 1.8

I hereby certify that this correspondence is being deposited on February 14, 2002 with the United States Postal Service as First Class Mail in an envelope addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231.

Date 2/19/02

Signature

## SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT

The Applicants, and the Attorney who signs below on the basis of the information supplied by the inventor and the information in his file, submit herewith patents, publications, or other information of which they are aware, which may be material to the examination of this application and in respect of which there may be a duty to disclose in accordance with 37 CFR § 1.56.

While the information submitted in this Supplemental Information Disclosure Statement may be material pursuant to 37 CFR § 1.56, it is not intended to constitute an admission that any patent, publication, or other information referred to therein is prior art for this invention unless specifically designated as such.

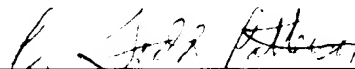
In accordance with 37 CFR § 1.97, this Supplemental Information Disclosure Statement is not to be construed as a representation that a search has been made or that no other possibly material information as defined under 37 CFR § 1.56(a) exists.

Form PTO-1449

180.00 CH

The Applicants do not feel that a fee is necessary at this time, if the sum of \$180.00 is due under 37 CFR § 1.17(p) pursuant to § 1.97, the Commissioner is hereby authorized to charge this fee, and any other fee necessary to make this submission timely, to the Deposit Account No. 20-0782/APPM/6303/CPI/COPPER/PJS/BTP.

Respectfully submitted,



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B. Todd Patterson  
Registration No. 37,906  
MOSER, PATTERSON & SHERIDAN, L.L.P.  
3040 Post Oak Blvd., Suite 1500  
Houston, TX 77056  
Telephone: (713) 623-4844  
Facsimile: (713) 623-4846  
Attorney for Applicants

U.S. Department of Commerce, Patent and Trademark Office (PTO Form 1449 modified)		Docket No. AMAT/6303/CPI/ COPPER/PJS	Serial No. 09/965,370
LIST OF PATENTS AND PUBLICATIONS CITED BY APPLICANT (Use several sheets if necessary)		Applicant Chung, et al.	
Examiner Unknown		Filing Date September 26, 2001	Group Unknown

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	A1	4,058,430	11/15/77	Suntola et al.	156	611	11/25/1975
	A2	4,389,973	06/28/83	Suntola et al.	118	725	12/11/1981
	A3	4,413,022	11/01/83	Suntola et al.	427	255.2	06/21/1979
	A4	4,486,487	12/04/84	Skarp	428	216	04/25/1983
	A5	4,767,494	08/30/88	Kobayashi et al.	156	606	09/19/1986
	A6	4,806,321	02/21/89	Nishizawa et al.	422	245	07/21/1985
	A7	4,829,022	05/09/89	Kobayashi et al.	437	107	12/09/1986
	A8	4,834,831	05/30/89	Nishizawa et al.	156	611	09/04/1987
	A9	4,838,983	06/13/89	Schumaker et al.	156	613	03/18/1988
	A10	4,838,993	06/13/89	Aoki et al.	156	643	12/03/1987
	A11	4,840,921	06/20/89	Matsumoto	437	89	06/30/1988
	A12	4,845,049	07/04/89	Sunakawa	437	81	03/28/1988
	A13	4,859,625	08/22/89	Nishizawa et al.	437	81	11/20/1987

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*Examiner Initial		Document Number	Date	Country	Class	Subclass	Translation	
							YES	NO
	B1	01/66832 A2	09/13/2001	WO	C30B	16/44		X
	B2	01/40541 A1	06/07/2001	WO	C23C	16/40		X
	B3	01/36702 A1	05/25/2001	WO	C23C	16/00		X
	B4	01/29893 A1	04/26/2001	WO	H01L	21/768		X
	B5	01/29891 A1	04/26/2001	WO	H01L	21/768		X

## OTHER ART

*Examiner Initial		Including Author, Title, Date, Pertinent Pages, Etc.
	C1	Hultman, et al., "Review of the thermal and mechanical stability of TiN-based thin films", <i>Zeitschrift Fur Metallkunde</i> , 90(10) (Oct. 1999), pp. 803-813.

\*EXAMINER

Date Considered

\*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with your communication to applicant.

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<b>U.S. Patent Documents</b>								
*Examiner Initial		Document Number	Issue Date	Applicant(s) Name	Class	Subclass	Filing Date If Appropriate	
	A14	4,859,627	08/22/89	Sunakawa	437	81	07/01/1988	
	A15	4,861,417	08/29/89	Mochizuki et al.	156	610	03/24/1988	
	A16	4,876,218	10/24/89	Pessa et al.	437	107	09/26/1988	
	A17	4,927,670	05/22/1990	Erbil	427	255.3	06/22/1988	
	A18	4,931,132	06/05/90	Aspnes et al.	156	601	10/07/1988	
	A19	4,960,720	10/02/90	Shimbo	437	105	08/24/1987	
	A20	4,975,252	12/04/90	Nishizawa et al.	422	245	05/26/1989	
	A21	4,993,357	02/19/91	Scholz	118	715	12/21/1989	
	A22	5,013,683	05/07/91	Petroff et al.	437	110	01/23/1989	
	A23	5,082,798	01/21/92	Arimoto	437	108	09/27/1990	
	A24	5,085,885	02/04/92	Foley et al.	477	38	09/10/1990	
	A25	5,091,320	02/25/92	Aspnes et al.	437	8	06/15/1990	
	A26	5,130,269	07/14/92	Kitahara et al.	437	111	04/25/1989	
	A27	5,166,092	11/24/92	Mochizuki et al.	437	105	10/30/1990	
<b>Foreign Patent Documents</b>								
*Examiner Initial		Document Number	Date	Country	Class	Subclass	Translation	
							YES	NO
	B6	01/29280 A1	04/26/2001	WO	C23C	16/32		X
	B7	01/27347 A1	04/19/2001	WO	C23C	16/44		X
	B8	01/27346 A1	04/19/2001	WO	C23C	16/44		X
	B9	01/15220 A1	03/01/2001	WO	H01L	21/768		X
<b>OTHER ART</b>								
*Examiner Initial		Including Author, Title, Date, Pertinent Pages, Etc.						
	C3	Yamauchi, et al. "Atomic-layer chemical-vapor-deposition of silicon dioxide films with extremely low hydrogen						

EXAMINER

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(Use several sheets if necessary)		Filing Date	Group
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	A28	5,225,366	07/06/93	Yoder	437	108	06/22/1990
	A29	5,246,536	09/21/93	Nishizawa et al.	156	610	03/10/1989
	A30	5,250,148	10/05/93	Nishizawa et al.	156	611	11/12/1991
	A31	5,254,207	10/19/93	Nishizawa et al.	156	601	11/30/1992
	A32	5,256,244	10/26/93	Ackerman	156	613	02/10/1992
	A33	5,270,247	12/14/93	Sakuma et al.	437	133	07/08/1992
	A34	5,278,435	01/11/94	Van Hove et al.	257	184	06/08/1992
	A35	5,281,274	01/25/94	Yoder	118	697	02/04/1993
	A36	5,290,748	03/01/94	Knuuttila et al.	502	228	07/16/1992
	A37	5,294,286	03/15/94	Nishizawa et al.	156	610	01/12/1993
	A38	5,296,403	03/22/94	Nishizawa et al.	437	133	10/23/1992
	A39	5,300,186	04/05/94	Kitahara et al.	156	613	04/07/1992
	A40	5,311,055	05/10/94	Goodman et al.	257	593	11/22/1991

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*Examiner Initial		Document Number	Date	Country	Class	Subclass	Translation	
							YES	NO
	B10	00/79576 A1	12/28/2000	WO	H01L	21/205		X
	B11	00/79019 A1	12/28/2000	WO	C23C	16/00		X
	B12	00/63957 A1	10/26/2000	WO	H01L	21/205		X

**OTHER ART**

*Examiner Initial		Including Author, Title, Date, Pertinent Pages, Etc.
	C5	George, et al., "Atomic layer controlled deposition of SiO <sub>2</sub> and Al <sub>2</sub> O <sub>3</sub> using ABAB...binary reaction sequence chemistry", <i>Appl. Surf. Sci.</i> , Vol. 82/83 (1994), pp. 460-467.
	C6	Wise, et al., "Diethyldiethoxysilane as a new precursor for SiO <sub>2</sub> growth on silicon", <i>Mat. Res. Soc. Symp. Proc. Vol. 224 (1994)</i> , pp. 27-32.

\*EXAMINER initial reference considered whether in conformance with applicable law or through citation if not in conformance and not considered. Include copy of this form with your communication to applicant.

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	Examiner	Examiner	

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	A41	5,316,615	05/31/94	Copel	117	95	03/09/1993
	A42	5,316,793	05/31/94	Wallace et al.	427	248.1	07/27/1992
	A43	5,330,610	07/19/94	Eres et al.	117	86	05/28/1993
	A44	5,336,324	08/09/94	Stall et al.	118	719	12/04/1991
	A45	5,338,389	08/16/94	Nishizawa et al.	117	89	04/21/1993
	A46	5,348,911	09/20/94	Jurgensen et al.	117	91	04/26/1993
	A47	5,374,570	12/20/94	Nasu et al.	437	40	08/19/1993
	A48	5,395,791	03/07/95	Cheng et al.	437	105	10/20/1993
	A49	5,438,952	08/08/1995	Otsuka	117	84	01/31/1994
	A50	5,439,876	08/08/95	Graf et al.	505	447	08/16/1993
	A51	5,441,703	08/15/95	Jurgensen	422	129	03/29/1994
	A52	5,443,033	08/22/95	Nishizawa et al.	117	86	03/11/1994
	A53	5,443,647	08/22/95	Aucoin et al.	118	723 ME	07/11/1994
	A54	5,455,072	10/03/95	Bension et al.	427	255.7	11/18/1992

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	B13	00/54320 A1	09/14/2000	WO	H01L	21/44		X
	B14	00/16377 A2	03/23/2000	WO	H01L	---		X
	B15	00/15881 A2	03/23/2000	WO	C30B	---		X
	B16	00/15865 A1	03/23/2000	WO	C23C	16/00		X

**OTHER ART**

*Examiner Initial		Including Author, Title, Date, Pertinent Pages, Etc.
	C7	Niinisto, et al., "Synthesis of oxide thin films and overlayers by atomic layer epitaxy for advanced applications". <i>Mat. Sci. &amp; Eng.</i> , Vol. B41 (1996), pp. 23-29.

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	A68	5,641,984	06/24/97	Aftergut et al.	257	433	08/19/1994
	A69	5,644,128	07/01/97	Wollnik et al.	250	251	08/25/1994
	A70	5,693,139	12/02/97	Nishizawa et al.	117	89	06/15/1993
	A71	5,705,224	01/06/98	Murota et al.	427	248.1	01/31/1995
	A72	5,707,880	01/13/98	Aftergut et al.	437	3	01/17/1997
	A73	5,711,811	01/27/98	Suntola et al.	118	711	11/28/1995
	A74	5,730,802	03/24/98	Ishizumi et al.	118	719	12/27/1996
	A75	5,747,113	05/05/98	Tsai	427	255.5	07/29/1996
	A76	5,749,974	05/12/98	Habuka et al.	118	725	07/13/1995
	A77	5,796,116	08/18/98	Nakata et al.	257	66	07/25/1995
	A78	5,807,792	09/15/98	Ilg et al.	438	758	12/18/1996
	A79	5,830,270	11/03/98	McKee et al.	117	106	08/05/1996
	A80	5,835,677	11/10/98	Li et al.	392	401	10/03/1996

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*Examiner Initial		Document Number	Date	Country	Class	Subclass	Translation	
							YES	NO
	B20	96/17107 A1	06/06/1996	WO	C23C	16/44		X
	B21	93/02111 A1	02/04/1993	WO	C08F	4/78		X
	B22	91/10510 A1	07/25/1991	WO	B01J	37/02		X
	B23	0 799 641 A2	10/08/1997	EP	B01J	20/32		X

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*Examiner Initial		Including Author, Title, Date, Pertinent Pages, Etc.
	C10	Min, et al., "Atomic layer deposition of TiN thin films by sequential introduction of Ti precursor and NH/sub3", <i>Symp.: Advanced Interconnects and Contact Materials and Processes for Future Integrated Circuits</i> (Apr. 13-16, 1999), pp. 227-242

EXAMINER: [ ] Reference considered, whether or not in conformance with an EPH. Drawn through citation if not in conformance and not considered. Include copy of this form with your communication to applicant.

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<b>U.S. Patent Documents</b>								
*Examiner Initial		Document Number	Issue Date	Applicant(s) Name	Class	Subclass	Filing Date If Appropriate	
	A81	5,851,849	12/22/98	Comizzoli et al.	438	38	05/22/1997	
	A82	5,855,675	01/05/99	Doering et al.	118	719	03/03/1997	
	A83	5,855,680	01/05/99	Soininen et al.	118	719	11/28/1995	
	A84	5,858,102	01/12/99	Tsai	118	719	02/14/1998	
	A85	5,879,459	03/09/99	Gadgil et al.	118	715	08/29/1997	
	A86	5,904,565	05/18/1999	Nguyen, et al.	438	687	07/17/1997	
	A87	5,916,365	06/29/99	Sherman	117	92	08/16/1996	
	A88	5,923,056	07/13/99	Lee et al.	257	192	03/12/1998	
	A89	5,923,985	07/13/99	Aoki et al.	438	301	01/14/1997	
	A90	5,925,574	07/20/99	Aoki et al.	437	31	04/10/1992	
	A91	5,942,040	08/24/99	Kim et al.	118	726	08/27/1997	
	A92	5,947,710	09/07/1999	Cooper, et al.	418	63	06/16/1997	
	A93	5,972,430	10/26/99	DiMeo, Jr. et al.	427	255.32	11/26/1997	
<b>Foreign Patent Documents</b>								
*Examiner Initial		Document Number	Date	Country	Class	Subclass	Translation	
							YES	NO
	B24	0 442 490 A1	02/14/1991	EP	C30B	25/02		X
	B25	0 344 352 A1	06/03/1988	EP	H01L	39/24		X
	B26	62-091495 A	04/25/1987	JP	C30B	25/02		X
<b>OTHER ART</b>								
*Examiner Initial		Including Author, Title, Date, Pertinent Pages, Etc.						
	C11	Klaus, et al., "Atomic Layer Deposition of Tungsten using Sequential Surface Chemistry with a Sacrificial Stripping Reaction," Thin Solid Films 360 (2000), Pages 145 - 153, (Accepted Nov. 16, 1999).						
	C12	Min, et al. "Metal-Organic Atomic-Layer Deposition of Titanium-Silicon-Nitride Films" Applied						

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	A94	6,001,669	12/14/99	Gaines et al.	438	102	07/21/1992	
	A95	6,015,590	01/18/00	Suntola et al.	427	255.23	11/28/1995	
	A96	6,025,627	02/15/00	Forbes et al.	257	321	05/29/1998	
	A97	6,036,773	03/14/00	Wang et al.	117	97	03/27/1997	
	A98	6,042,652	03/28/00	Hyun et al.	118	719	09/07/1999	
	A99	6,043,177	03/28/00	Falconer et al.	502	4	01/21/1997	
	A100	6,124,158	09/26/00	Dautartas et al.	438	216	06/08/1999	
	A101	6,113,977	09/05/00	Soininen et al.	427	64	09/11/1997	
	A102	6,130,147	10/10/00	Major et al.	438	604	03/18/1997	
	A103	6,139,700	10/31/00	Kang et al.	204	192.17	09/30/1998	
	A104	6,174,377	01/16/2001	Doering, et al.	118	729	01/04/1999	
	A105	6,174,809	01/16/2001	Kang, et al.	438	682	12/15/1998	
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	B27	60-065712 A	04/15/1985	JP	C01B	33/113	YES	NO
	B28	03-048421	03/01/1991	JP	H01L	21/302		X
	B29	03-286531	12/17/1991	JP	H01L	21/316		X
<b>OTHER ART</b>								
*Examiner Initial		Including Author, Title, Date, Pertinent Pages, Etc.						
	C13	Martensson, et al., "Atomic Layer Epitaxy of Copper on Tantalum", <i>Chemical Vapor Deposition</i> , 3(1) (Feb. 1, 1997), pp. 45-50.						
	C14	Ritala, et al. "Atomic Layer Epitaxy Growth of TiN Thin Films", <i>J. Electrochem. Soc.</i> , 142(8) (Aug. 1995), pp. 2731-737.						
	C15	Elers, et al. "NbC15 as a precursor in atomic layer epitaxy" <i>Appl. Surf. Sci.</i> Vol. 82/83 (1994) pp.						

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	A106	6,200,893	03/13/2001	Sneh	438	685	03/11/1998
	A107	6,203,613	03/20/2001	Gates, et al.	117	104	10/19/1999
	A108	6,207,302	03/27/2001	Sugiura, et al.	428	690	03/02/1998
	A109	6,248,605	06/19/2001	Harkonen, et al.	438	29	06/02/1999
	A110	6,270,572	08/07/2001	Kim, et al.	117	93	08/09/1999
	A111	6,287,965	09/11/2001	Kang, et al.	438	648	02/23/2000
	A112	6,291,876	09/18/2001	Stumborg, et al.	257	632	08/20/1998
	A113	6,305,314	10/23/2001	Sneh, et al.	118	723 R	12/17/1999
	A114	6,306,216	10/23/2001	Kim, et al.	118	725	07/12/2000
	A115	6,316,098	11/13/2001	Yitzchaik, et al.	428	339	03/23/1999
	A116	2001/0000866	05/10/2001	Sneh, et al.	118	723 R	11/29/2000
	A117	2001/0009140	07/26/2001	Bondestam, et al.	118	725	01/25/2001

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*Examiner Initial		Document Number	Date	Country	Class	Subclass	Translation	
							YES	NO
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	B31	06-291048	10/18/1994	JP	H01L	21/205		X
	B32	08-264530	10/11/1996	JP	H01L	21/3205		X
	B33	11-269652	10/05/1999	JP	C23C	16/44		X

## OTHER ART

*Examiner Initial		Including Author, Title, Date, Pertinent Pages, Etc.
	C16	Lee, "The Preparation of Titanium-Based Thin Film by CVD Using Titanium Chlorides as Precursors", <i>Chemical Vapor Deposition</i> , 5(2) (Mar. 1999), pp. 69-73.
	C17	Martensson, et al., "Atomic Layer Epitaxy of Copper, Growth & Selectivity in the Cu (II)-2,2,6,6-Tetramethyl-3, 5-Heptanedion ATE/H <sub>2</sub> Process", <i>J. Electrochem. Soc.</i> , 145(8) (Aug. 1998) pp.

\*EXAMINER Initial reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with your communication to applicant.

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<b>LIST OF PATENTS AND PUBLICATIONS CITED BY APPLICANT</b>		Applicant Chung, et al.	
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	A56	5,469,806	11/28/95	Mochizuki et al.	117	97	08/20/1993
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	A66	5,616,181	04/01/97	Yamamoto et al.	118	723 ER	11/21/1995
	A67	5,637,530	06/10/97	Gaines et al.	114	105	06/10/1996

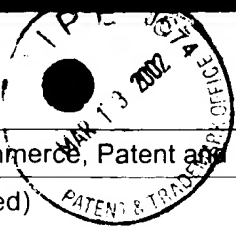
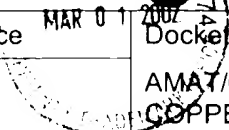
**Foreign Patent Documents**

*Examiner Initial		Document Number	Date	Country	Class	Subclass	Translation	
							YES	NO
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	C9	Klaus, et al., "Atomically controlled growth of tungsten and tungsten nitride using sequential surface reactions" <i>Appl. Surf. Sci.</i> Vol. 162-163 (2000) pp. 479-491.

\*EXAMINER Initial: Reference considered. Whether or not citation is in conformance with 37 CFR 1.97(d) will be through citation if not in conformance and not considered. Include copy of this form with your communication to applicant.

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Unknown

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	A119	2001/0031562	10/18/2001	Raaijmakers, et al.	438	770	02/22/2001
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*Examiner Initial		Document Number	Date	Country	Class	Subclass	Translation	
							YES	NO
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	B37	2 626 110	07/21/1989	FR	H01L	39/24		X
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	C18	Min, et al., "Chemical Vapor Deposition of Ti-Si-N Films with Alternating Source Supply", <i>Mat. Res. Soc. Symp. Proc.</i> , Vol. 564 (Apr. 5, 1999), pp. 207-210
	C19	Bedair, "Atomic layer epitaxy deposition processes", <i>J. Vac. Sci. Technol.</i> 12(1) (Jan/Feb 1994)
	C20	Yamaga, et al., "Atomic layer epitaxy of ZnS by a new gas supplying system in a low-pressure metalorganic vapor phase epitaxy", <i>J. of Crystal Growth</i> 117 (1992), pp. 152-155
	C21	Elam, et al., "Nucleation and growth during tungsten atomic layer deposition on SiO <sub>2</sub> surfaces," <i>Thin Solid Films</i> 386 (2001) Pages 41 – 52, (Accepted Dec. 14, 2000).

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applicant